Canal Irrigation System

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Defn: Canal is defined as the conduit used for transporting water from source (head) to the field. Canals typically flow under the influence of gravity and may be line or unlined as per the requirement.

Classification of Canals:

1) Based on nature of source of supply

A. Permanent canals (have continuous flow of water)

✓ Perennial canal : These canal gets continuous supplies from the sources throughout the river.ie from the perennial river

✓ Non-perennial canal: This canal gets supply only for some part of year

B. Inundation canals (flood water management, flow above certain water level)

2) Based on the function of the canal

- Irrigation canal (used to carry water to the field)
- Hydropower canal (Used to carry to powerhouse for hydropower generation)
- Feeder canal (only feeds other canals)
- Carrier canals (carries water for direct irrigation and also to feed another canal)

3) Based on discharge in canal and its importance in canal network

- Main channel
- Branch canal (discharge > 5cumec)
- Major distributary (0.25 – 5 cumec)
- Minor distributary (less than 0.25 cumec)
- Water course or field channel (owned and constructed by the farmers)

4) Based on canal alignment

- Ridge canal/watershed canal
  - Canal flows along the ridge line.
  - It can irrigate the commanded area on its both sides
  - Since stream originate from ridge line, no natural drain crosses the canal hence, no cross drainage required

2) **Contour Canal**

- In hilly regions, it is unfeasible to run canal along the ridge as large elevation difference between valley and ridge.
- Canal aligned along natural contours of the ground is contour canal
- Irrigates only one side of commanded area
- Encounters large no of natural drains. Hence, more cross drainage structures required
- Generally preferred in hilly terrain

3) **Side slope Canal**

- Flow perpendicular to contour lines in between ridge and valley line.
- Less number of natural drains is encountered.
- Can irrigate only one side of the command area

5) Based on financial output

- Protective canal (to protect particular area from famine)
- Productive canal (to generate revenue to the nation)

6) Based on the soil through which it is constructed

- Alluvial canal (Canal formed on alluvial soil i.e soft soil)
- Non-alluvial canal (Canal formed on Non-alluvial soil i.e hard rock)

7) Based on the presence of lining

Lined canals: Canals with their surface lined by impervious materials like concrete, brick etc

Unlined canals: Canals with their surface in natural condition. May be alluvial or non alluvial

Consideration in canal alignment:

1) Maximum area should be irrigated with least length of canal. Alignment should encounter minimum no of cross drainage works.
2) The point where it takes off from the river it mounts the watershed in the shortest possible distance.
3) Alignment may need to be changed in order to bypass towns or villages.
4) In hilly areas it may not be possible to carry canal on the ridge due to large elevation difference between valley and ridge.
5) Curves should be avoided as far as possible. If provided should be 3 to 7 times the water surface width.
6) Idle or unirrigated length of the canal should be minimum.
7) Balanced in cutting and filling is achieved.
8) Should not be in rocky, brakish or cracked strata.
9) Canal should cross the natural streams at right angle with minimum waterway width.

Canal alignment

Canal alignment

- The alignment should not pass through the valuable lands, religious land, villages etc.
- The alignment should be as short as possible but, in an attempt, to make alignment short canal should not be aligned where irrigation is not possible.
- If curves are unavoidable in the alignment, the curves should be provided taking the table 1 as basis:

Table: Radius of curvature for channel curves

Discharge (m^3/s)	Radius (m)
80-100	1200-1500
30-80	800-1000
15-30	400-600
5-15	100-150

Canal Alignemnt

- The canal should cross natural drainage, stream etc. at right angle. The width of drainage should be minimum and the banks should be well defined at the crossing point.
- The alignment should not involve heavy cutting or banking i.e. balanced cutting and banking should be preferred.
- The canal should be aligned in watershed line as possible.
- The alignment should be as straight as possible.
- The alignment should be such that the maximum area is irrigated with minimum length.
- The alignment should not pass through the marshy land or water-logged area as the canal may collapse due to heavy moisture in area.
- The alignment should not pass through sandy soil as the percolation loss will be high consequently decreasing the duty of canal.

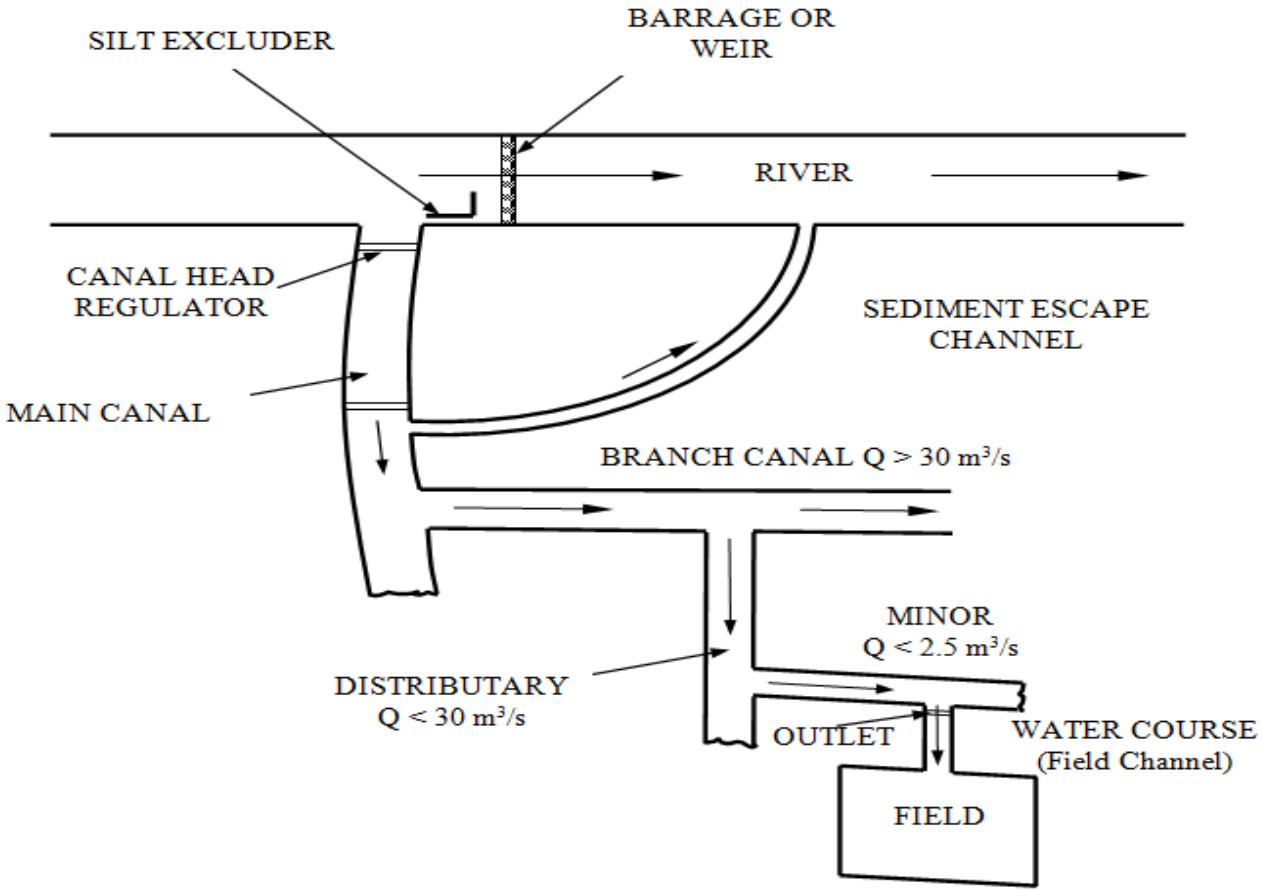
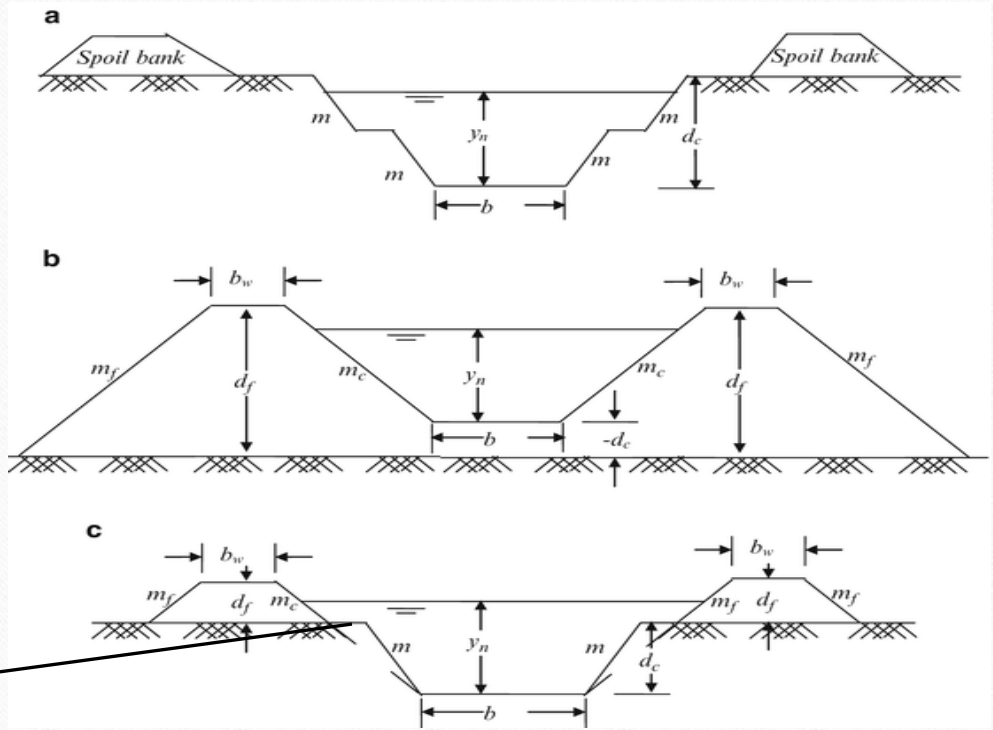


Fig: Layout of an irrigation canal network

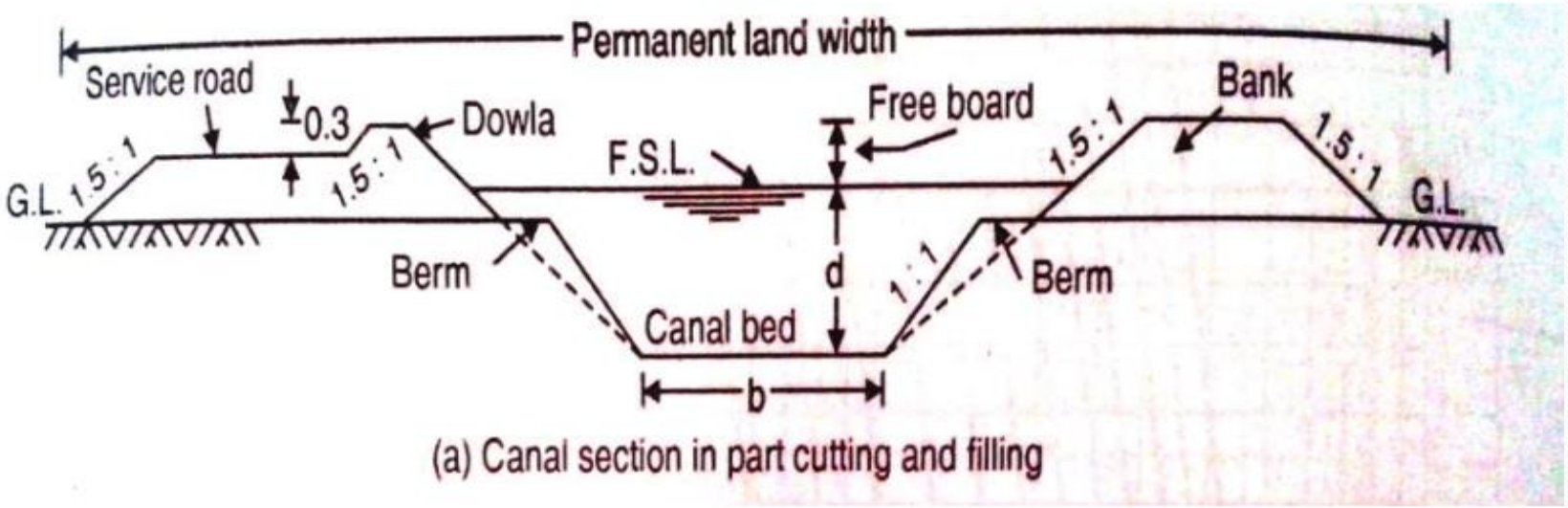
Canal Cross section

Canal section is formed by three different method of eartwork. They are:

a) Fully cutting b)fully filling c) partly cutting partly filling



Cross-section of canal:-



(a) Canal section in part cutting and filling

Canal standards and balancing depth

Freeboard(FB)

- Margin between FSL (Full supply level) and bank level
- Depends upon discharge in the canal

Discharge in cumec	Extent of free board in meter
1 to 5	0.50
5 to 10	0.60
10 to 30	0.75
30 to 150	0.90

Canal banks

- Primary purpose is to retain water
- Used for inspection and serves as means of transportation.
- Should be constructed of less permeable material.
- Bank slopes should be well protected against erosion.

Canal banks

- Primary purpose is to retain water
- Used for inspection and as means of communication
- Should be wide enough so that at least 0.5 m cover is available above saturation line

Service roads:

- Roads provided on canals for inspection purpose
- Simultaneously used for means of communication
- Generally provided 0.4 m to 1.0 m above FSL depending upon canal size.

Dowlas :

- Dowlas are small embankments by the side of service roads
- Generally height is 0.3 m and width at the top is 0.3 to 0.6 m
- For safety in driving on service roads

Balancing depth of canal:

The depth of cutting that will result in balance of earthwork i.e. earthwork of excavation equal to that of filling is called balancing depth.

If the balance between cutting and feeling occur, the need of spoil bank and borrow pits are completely eliminated

Spoil bank

- Constructed when earthwork in excavation exceeds earthwork in filling
- Disposal of such soil may become uneconomical my mechanical means
- Deposited heaps of soil on the bank
- Spaced at regular intervals

Borrow pits

- When earthwork in filling exceeds earthwork in excavation, borrow pits are dug
- Borrow pits may be external(outside the canal) or internal (somewhere inside the canal)
- External borrow pits should be avoided to prevent the breeding of mosquitoes

Berms

Horizontal distance left at ground level between toe of bank and edge of cutting

Berms are provided for following purposes:

- Deposited silt acts as lining to the canal and reduce seepage
- Saturation line lies within the body of embankment due to berms
- Protect bank from erosion and breach
- Scope for future expansion

Canal losses due to seepage and evaporation

Canal losses due to seepage and evaporation

- Water loss either by **evaporation** from the surface or by **seepage** through the peripheries of the channels.
- While determining the designed channel capacity, a provision for these losses must be made.
- The losses are sometimes as high as 25 to 50% water diverted.

Evaporation

- The water lost by evaporation depends on temperature, wind velocity, humidity etc.
- Generally, the water lost by evaporation is 2 to 3% of total loss but may be up to 10%.

Seepage

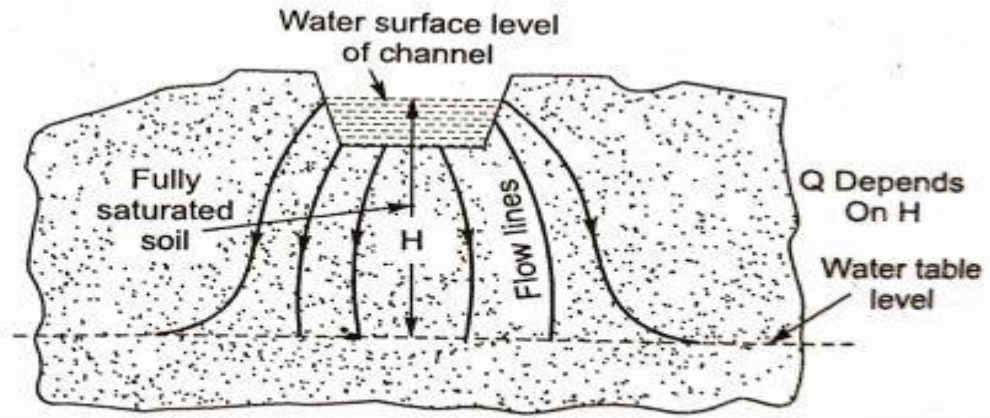
Seepage loss occurs by two mechanism: **percolation** and **absorption**.

Canal losses due to seepage and evaporation: Seepage

Percolation loss

- In percolation, there exist a zone of continuous saturation from the canal to the water table and a direct flow is established.
- Almost all water lost from the canal joins the ground water reservoir.
- Percolation loss is very high compared to absorption.

Figure: Percolation Loss

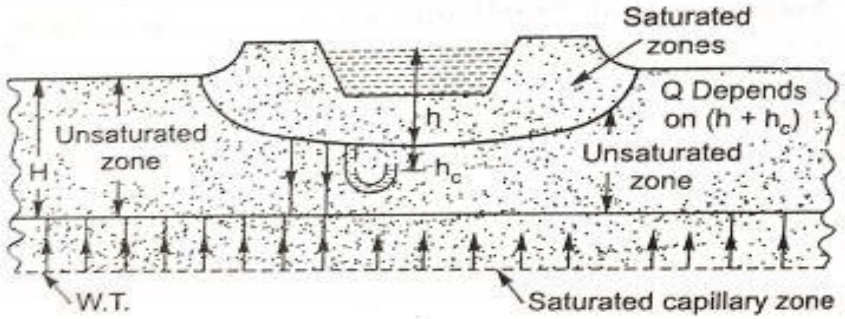


Canal losses due to seepage and evaporation: Seepage

Absorption loss

- In absorption, a small saturated soil zone exists round the canal section, and is surrounded by zone of decreasing saturation.
- A certain zone above the water table is saturated by capillarity.
- Unsaturated zone exists between the two saturated zones.

Figure: Absorption Loss



Canal losses due to seepage and evaporation: Seepage

Seepage losses depend on

- Type of seepage: whether **percolation** or **absorption**
- Permeability of soil
- Condition of canal: whether silted or new (loss through silted canal is less)
- Amount of silt carried by canal: more silt less losses
- Velocity of canal water: more velocity, lesser the losses
- Cross section of the canal and wetted perimeter.

Thank
you